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VARIABLE TEMPERATURE SEAT**Background of the Invention****Field of the Invention**

15 The invention provides a method and apparatus for
climate control of an individualized occupant seat. In
the practice of this invention, there is a method and
apparatus for providing conditioned air to a vehicle
20 seat's occupant. Conditioned air is obtained from a
central source in the vehicle and is channeled through the
seat. The air is then separated into a plurality of
smaller subchannels via a manifold. The air is then
further divided up, i.e., diffused, through a layer of
reticulated foam. This reticulated foam takes the place
25 of the upholstery backing foam that is normally used in a
vehicle seat. The air passes through the foam, both
perpendicular to, as well as parallel with, the seat
cushion surface. The air, in exiting the reticulated
foam, is directed through the seat covering. The air
30 provides for heating and cooling of the vehicle seat's
occupant.

Prior Art

35 Temperature modified air for environmental control of
living or working space is typically provided to
relatively extensive areas, such as entire buildings,
selected offices, or suites of rooms within a building.

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1 In the case of vehicles, such as automobiles, the entire
vehicle is cooled or heated as a unit. There are many
situations, however, in which more selective or
restrictive air temperature modification is desirable, the
5 ultimate use of which is to enhance the comfort of human
beings. For example, it is desirable to provide a chair
or seat, the immediate surroundings of which can be
selectively cooled or heated, and yet the modified effect
cannot be noted to any substantial extent beyond that
10 range.

It is also desirable to provide an individualized
climate control for an occupant seat so that substantially
instantaneous heating or cooling can be achieved. For
example, an automotive vehicle exposed to the summer
15 weather, where the vehicle has been parked in an unshaded
area for a long period of time, can cause the vehicle seat
to be very hot and uncomfortable for the occupant for some
time after entering and using the vehicle, even with
normal air conditioning. Even with normal air-
20 conditioning, on a hot day, the seat occupant's back and
other pressure points may remain sweaty while seated.
Also, in the winter time, it is highly desirable to have
the ability to quickly warm the seat of the occupant to
facilitate the occupant's comfort, especially where the
25 normal vehicle heater is unlikely to warm the vehicle's
interior as quickly. For such reasons, there has long
been a desire for a seat which provides for the comfort of
human beings primarily by cooling or heating the occupant,
as desired by the user.

30 One technique employed to attempt to provide occupant
individualized comfort has been to use seating which
either warms or cools the occupant via conduction. This
embodiment requires a number of currently non-standard
components, such as specialized coil spring elements
35 specifically configured for heat transfer, multiple layers
of material to enclose the non-standard coil springs, and
additional air flow barrier layers.

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1 One limitation of this embodiment is that it does not
use common elements presently available that can be used
to construct vehicle seats. While this embodiment
provides some heating and cooling, it nevertheless does
5 not achieve optimal operation without sacrifice of the
comfort of the user. Also, excessive accumulation of
condensate can occur, with the potential of spilling and
damaging the vehicle in the vicinity of the seat.

Yet another technique employed to provide localized
10 heating and cooling of an occupant has been to alter the
above technique by allowing some of the conditioned air to
escape the confines of the seat in order to provide some
convection cooling or heating of the occupant. However,
the same problems of non standard and specialized parts
15 remains. For example, non-standard oval helically wound
metal wire springs or molded plastic tubes, and a bladder-
type containment layer for specialized fluids to
facilitate the heat transfer are used. Other non-standard
parts can include metal wire plenum coils or layers of
20 copper or aluminum cloth. Yet another non-standard part
that may be used in the seat construction is a pair of
plastic sheets in facing relationship and heat sealed at
a number of points and that also requires a Fluorinert
liquid in order to provide for high thermal transfer
25 properties. A condensate collection system is preferably
needed along with the air conditioning unit, requiring
more complex parts and maintenance. If the condensate
collection system were not provided, then undue liquid
accumulation would occur within the main exchanger housing
30 for conditioned air. This is undesirable because
excessive condensate accumulation reduces the main
exchanger performance.

Further problems with the techniques available are
that the air conditioning supply units and their
35 accompanying condensate collection systems may require
additional wiring apparatus. This includes requiring
electrical cabling that is plugged into the cigarette

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1 lighter socket of an automobile in order to power the
equipment.

Other problems that have been experienced with
existing techniques include that the construction of the
5 seats are not easily integratable into existing seat
construction methods. The techniques require a
significantly greater number of parts as compared to
existing automotive seats, and often require non-standard
parts. The parts used are typically more complex than
10 other existing air distribution methods. In the past,
this has lead to increased costs if individualized
occupant cooling was provided. Also, the mechanical
comfort of the seat is appreciably affected in the
techniques employed, as compared to the comfort provided
15 by standard automotive seats, wherein the user is able to
distinguish between the comfort of the two. Further, the
current techniques are problematic in the ability for
vehicle designers to provide modern seating embodiments
and stylistic designs. Yet another problem is that the
20 techniques employed above do not provide good insulation
for holding conditioned air until it is used by the
occupant.

Therefore, it is desirable to provide a simple
construction of a vehicle occupant seat which requires
25 little, if any, non-standard parts and which utilizes
commonly available materials. It is contemplated that a
simple seat construction can be utilized as an automobile
seat or other such seating embodiment where the occupant
desires to be at a different environmental comfort zone
30 than the surrounding users of the vehicle, room or office.
The amount of conditioned air is modest because the area
to be cooled or heated is relatively small and localized
so that it will not disturb others in the vehicle or room.

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1 Summary of the Invention

 The present invention relates to an improved method and apparatus for providing conditioned air to the occupant of a vehicle seat without requiring a significant amount of extra parts or increased costs, as compared to a standard vehicle seat. Air distribution to the occupant is provided without having to use exotically designed parts and does not compromise the mechanical comfort of the seat. Further, the invention allows for the use of a plurality of various air conditioning sources.

 In an embodiment, the conditioned air is channeled from an inlet to the relative top or seating surface side of the seat cushion through one main channel opening. The air flow then branches off via a single manifold to a plurality of subchannels which travel along the seating surface side of the interior foam cushion. The air then exits the subchannels via a reticulated foam layer. The reticulated foam layer facilitates both perpendicular, as well as parallel, air flow relative to a seating surface side of the foam. The air travels to the seat cushion seating surface and exits the seat through an air permeable fabric. Air flow through the seat provides for relatively quick comfort adjustment of the seat's occupant. The air flow can also be used to initially warm up or cool down the seat prior to use by the occupant, if desired.

 An alternate embodiment of the invention involves dividing the air into a plurality of main channels on the bottom of the interior foam seat cushion, where the bottom represents the surface opposite the occupant seating surface. The air then enters a plurality of local manifolds, travels to the top surface of the interior foam cushion, and exits the manifold along a plurality of subchannels. Each group of subchannels preferably service a single manifold. The air then travels along the top surface of the seating cushion and is diffused through a

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1 layer of reticulated foam and onto the occupant, as
previously described.

Other variations of this invention are possible. For
example, if desired, a secondary structure may be
5 incorporated into the interior foam cushion to assist
supporting the channel side walls, in order to prevent
them from crushing under the weight of the seat's
occupant.

In yet another alternate embodiment, the seams that
are already present in the seat can be utilized as either
10 primary or secondary channels to direct air flow next to
the occupant. The sewn seams can be utilized as
distribution channels, to supplement or replace the
reticulated foam layer. Air distribution is accomplished
15 through the seat's sewn seams to direct air to the
occupant from the channels or subchannels. The seams have
the advantage of eliminating any barriers of fabric and
allowing the air to flow so that it will be in direct
contact with the occupant.

20 The invention is easily integratable into existing
seat construction methods. In a preferred embodiment, the
invention requires substantially the same number of parts
as existing automotive seats. Using less parts and
complexity than previous air distribution techniques
25 results in a lower cost to utilize this invention.
Further, the mechanical comfort of the seat is not
appreciably affected, as generally the same basic types of
materials that are used in vehicle seats today are
utilized for the air distribution method and apparatus.
30 The seat styling and design are also not appreciably
changed. Finally, the inherent tendencies of the existing
foam construction of vehicle seats is a good insulator for
holding and maintaining the conditioned air until it is
delivered to the seat occupant. This achieves maximum
35 comfort levels, that this invention provides in a very
energy efficient mode, while requiring no complex systems
or devices in order to practice this invention.

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1 Brief Description of the Drawings

These and other features, aspects, and advantages of the present invention will be appreciated as the same become better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a sectional view of the air plenums of the seat cushion;

10 FIG. 2 is a plan view schematic representation of an alternate embodiment of the distribution channels contained in a seat cushion;

FIG. 3 is a sectional view of the cushion as shown in FIG. 2;

15 FIG. 4 is a perspective view of yet another air plenum embodiment, wherein the seat covering is not shown for clarity and which illustrates a method for reinforcing the air plenums;

FIG. 5 is a sectional view of the air plenum strengthening method as shown in FIG. 4;

20 FIG. 6 is a sectional view of an alternate embodiment of providing diffused air from the air plenums to the seat user/occupant;

25 FIG. 7 is a side view schematic representation of one embodiment of the invention illustrating the overall air circulation path;

FIG. 8 is a sectional view illustrating the path of air in the interior portion of the seat depicted in FIG. 7;

30 FIG. 9 is an alternate embodiment of the internal air flow path of the seat embodiment as shown in FIG. 7;

FIG. 10A is a top sectional view of yet another alternate embodiment of the internal air flow path of the seat embodiment as shown in FIG. 7; and

35 FIG. 10B is a side sectional view of the alternate embodiment of the internal air flow path of the seat embodiment as shown in FIG. 10A.

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1 Detailed Description

 In a first embodiment of the invention, conditioned
air 5, represented by arrows, is supplied to the air inlet
12 of an automotive seat cushion 10 as shown in FIG. 1.
5 The conditioned air 5 passes through the main channel 14
and is divided via the manifold 20 into subchannels 16,
17, as shown in FIG. 1. The air inlet 12 is located on
the entrance side 22, and is opposite the occupant side 24
of the seat cushion 10. The air inlet 12, the channel
10 walls 15, and a portion of the subchannel walls 26, 27 are
substantially formed by standard automotive seat cushion
foam material 30. The subchannel walls 36, 37 nearest the
occupant side 24 of the seat cushion 10 preferably are
formed by reticulated foam 40. The reticulated foam is
15 encapsulated by a layer of automotive upholstery 42 that
is preferably air permeable.

 The conditioned air 5 passes from the subchannel
regions into the reticulated foam layer 40. Within the
reticulated foam, the conditioned air is free to move both
20 vertically and horizontally relative to the occupant
side 24 of the seat cushion 10. The conditioned air then
exits the reticulated foam through the automotive
upholstery to impinge the occupant, wherein the occupant
is in close proximity to the occupant side 24 of the
cushion 10. In this manner, the occupant is heated or
25 cooled, as desired, by the conditioned air.

 FIGS. 4 and 5 illustrate an alternate embodiment of
the invention. General structural details of the
alternate embodiment of FIGS. 4 and 5 are generally
30 similar to the embodiment described in FIG. 1. FIG. 4
shows a perspective view of the channels 16, 17, 18 that
have been cut into the foam 30. The reticulated foam
layer 40 and the automotive upholstery layer 42 have been
removed from FIG. 4 for clarity. This alternate
35 embodiment provides for a wide piece of adhesive-backed
material 50, which forms the occupant side of the
subchannel wall 17. In this embodiment, the adhesive-

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1 backed material covers the occupant side 24 of the seat
cushion foam 30, such that the subchannels 16, 17, 18 are
completely covered. The adhesive-backed material is
5 suitably permeable to air, which may include a plurality
of perforations, as required, throughout the adhesive-
backed material. This allows for air to pass from the
subchannels to the reticulated foam 40. The adhesive-
backed material assists in resisting the tendency of the
subchannels to crush when the occupant is seated upon the
10 cushion.

The adhesive-backed material may also provide for
additional occupant comfort. For example, the adhesive-
backed material assists in making the subchannels
substantially unnoticeable to the occupant's hand when
15 feeling the seat. The subchannels are unnoticeable
because the channels are structurally covered by the
adhesive-backed material. Therefore, for example, the
penetration by a hand into the subchannels, and
penetration of the reticulated foam layer and seat
20 covering into the subchannels when depressed by the
occupant or the occupant's hand, is prevented. This
provides a structural benefit as well as an aesthetic one,
wherein the adhesive-backed material assists in the
occupant's lack of awareness of the subchannels in the
25 seat cushion.

An alternative embodiment to prevent potential
crushing, is that the walls of the channels, manifold, and
subchannels formed by the automotive seat cushion foam 30
can be augmented. The walls are augmented with, for
30 example, stiffeners or liners placed cooperatively with
the walls or affixed to the walls, as desired, in order to
provide additional stiffness to the walls. Also,
stiffeners can be placed within the cavities of the
channels, manifold, and subchannels to resist crushing.
35 The stiffeners would preferably have suitable holes or
paths for the air flow to pass through, such that there is
not a substantial resistance to air flow.

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1 While the wide perforated or air permeable adhesive-
backed material is not preferably used in the practice of
this invention, a tape such as the one described, or other
alternate materials, may be used. For example, gluing a
5 very porous material, such as a strong cheesecloth-like
material, over the subchannels would be another manner of
providing extra strength or support to the subchannels.
If a adhesive-backed layer is used, it is preferable that
it have relatively minimal stretch characteristics, as
10 well as being more porous, relative to the foam seat
cushion material 30.

 The reticulated foam is preferably polyurethane or
the like, with approximately 20 pores per inch (ppi).
Other porosities, such as 10 ppi, and 30 or 40 ppi, are
15 also acceptable. Currently, 20 ppi is the preferred foam
type, as there is a slight drop off in the breathability
of the foam above 20 ppi.

 Another alternate embodiment of the invention is
shown in FIGS. 2 and 3. This alternate embodiment
20 provides for a different configuration of the air channel
distribution system. Conditioned air 105, represented by
arrows, enters the seat cushion 110 at air inlet 112. Air
is guided along a plurality of lower main channels 114.
The lower main channel walls 115 are formed by the surface
25 of a resilient material 160 which separates the seat
cushion 110 from the seat cushion springs 162. The upper
main channel walls 116 are formed by seat cushion foam
material 130. Air is then guided into the respective
manifold channels 121. The manifold channel walls 126 are
30 substantially formed by the seat cushion foam 130.

 The conditioned air is next directed into the
manifold area 120 where the air is further divided into
the respective subchannels 132, 133, 134, 135, 136, 137.
From this point on, the air travels a path substantially
35 similar the air path described in the first embodiment,
i.e., the conditioned air passes through the reticulated
foam layer 140 and through the preferably air permeable

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1 automotive upholstery 142 in order to cool or heat the
occupant.

As in the first embodiment, the automotive upholstery
142 encapsulates the reticulated foam layer 140. The
5 reticulated foam layer forms the occupant side 124
subchannel boundary wall 145 of the respective subchannel
135 and performs a similar wall forming function for the
other subchannels.

FIG. 6 shows yet another embodiment in the practice
10 of this invention. Seat cushion foam 30 again forms the
lower walls 26, 29 of the subchannels 16, 19. The upper
subchannel walls 36, 39, are the part of the subchannel
which is in closest proximity to the occupant side 24 of
the seat cushion section 61, as shown in FIG. 6. Sewn
15 stitching 62 is used to collapse the reticulated foam
layer 40 and the automotive upholstery fabric 42 through
the subchannels 16, 19 and into the seat cushion foam 30.
By using the stitching 62 to collapse the seat covering,
a "valley" 44 is formed in the seat cushion. The valley's
20 convergence is formed by the sewn stitching 62. This
valley provides a path for the exiting conditioned air to
travel along, in order to provide comfort for the
occupant. This valley provides for an additional path for
the conditioned air 5 through the reticulated foam layer
25 and the automotive seat covering to the occupant of the
seat.

In another alternate embodiment, the reticulated foam
layer 40 may be omitted, and the seams 62 used as the
primary diffusion areas for directing the conditioned air
30 to the occupant from the subchannels via the valleys. The
sewn seam diffusion area, or valley embodiment, may be
used with any of the alternate embodiments described in
connection with this invention, either with or without
foam layers such as the currently preferred reticulated
35 foam layer.

The seat coverings or automotive upholstery used in
any of the described embodiments is preferably of an air

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1 permeable fabric or synthetic. However, other materials
can be used, such as leather. To help facilitate air flow
through alternate materials, such as leather, the sewn
seam diffusion techniques described can be employed.
5 Preferably, materials such as leather are perforated with
small holes, in addition to the stitching holes of the
sewn seam diffusion technique, to facilitate the air flow.
For example, the holes can be approximately the same size
or larger than the holes made by the stitching of
10 automotive seat coverings. In addition, the holes can be
used together with the sewn seam diffusion techniques.
Alternate sized holes, either larger or smaller, can also
be used. However, the smaller the holes, assuming the
number of holes remains constant, the more the cooling
15 will rely upon conduction rather than convection for
cooling the occupant. As the holes become smaller, the
convective air flow is proportionately reduced.

FIGS. 7 and 8 show yet another alternate embodiment
of the invention. As schematically shown in FIG. 7,
20 conditioned air 205, represented by arrows, enters the air
inlet 212 of the seat configuration 210. The conditioned
air is then divided among a plurality of channels 214 at
a manifold area 220. The conditioned air travels along
the channels 214 from the manifold area 220 to the foot
25 outlet 217 or the head outlet 218. As shown in FIG. 7,
the foot outlet 217 exhausts near the occupant's feet.
However, the head outlet 218 exhausts out the "back", or
non-occupant side of the seat. Alternately, the seat may
provide for a head outlet that exhausts on the occupant
30 side 224, preferably near the neck area of the occupant.
In this alternate embodiment, air exiting at the head and
foot outlets facilitate cooling in these respective
locations of an occupant that is in close proximity to the
occupant side 224.

35 Conditioned air 205 is able to cool the occupant of
the seat, via an air flow path through the seat fabric, as
well. Conditioned air traveling via the channels 214 is

1 directed at and near the occupant through an air permeable
seat covering 242. A reticulated foam layer is omitted in
this embodiment, though it can be added, if desired.

5 FIG. 8 shows a plurality of air channels 214 which
are formed in the seat cushion foam 230. This sectional
view also shows a side support "wing" 239 of the seat,
wherein the air channels do not occupy this region of the
seat cushion foam. However, in an alternate embodiment,
the channels can extend even into these areas of the seat,
10 if desired.

Yet another embodiment of the foam air distribution
channels as schematically shown in FIG. 7 is shown in
FIG. 9. Here the foam seat cushion 230 is of a foam
density which is less than the foam density of the air
15 channel forming foam 231. Air channels 215 formed by the
denser air channel foam 231, cooperating with the
automotive upholstery 242, is used in place of the air
channels 214 as schematically shown in FIG. 7. An
adhesive may be used to bond the automotive upholstery 242
20 to the air channel foam 231 at bond line 157. A
relatively non-permeable barrier 258, constructed of a
synthetic material, can be placed between the air channel
foam 231 and the seat cushion foam 230 to provide for a
pneumatic, moisture, or thermal barrier, as desired.

25 Another embodiment of the denser air channel foam 231
of FIG. 9 is shown in FIGS. 10A and 10B. Inlet
conditioned air is supplied to a first plurality of
channels 270, which are oriented relatively perpendicular
to the plurality of channels 214, 215 as previously shown
30 in FIGS. 7, 8, and 9, and are also perpendicular to the
second plurality of channels 272, as shown in FIG. 10A.
The second plurality of channels 272 are oriented
substantially similar to the plurality of channels as
shown in FIGS. 7, 8, and 9. Channels 270 cooperate with
35 channels 272, such that the conditioned air is able to
pass from the first plurality of channels 270 to the
second plurality of channels 272 via a plurality of

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1 overlapping common manifold areas 274. A common manifold
area 274 preferably occurs at each intersection of a first
channel with a second channel.

5 The relatively dense air channel forming foam 231 of
FIGS. 10A and 10B can be substituted for the foam 231 as
shown in FIG. 9, and may be used with or without the
non-permeable barriers, as well as with or without the
adhesive layers. The permeable automotive upholstery can
be augmented or replaced, as desired, with a stitching
10 embodiment as an air flow path to the occupant, as
previously described.

The air channel forming foam 231 of the embodiments
shown in FIGS. 9, 10A, and 10B is preferably approximately
12 pounds per cubic foot and the seat cushion 230 foam is
15 preferably approximately 6 pounds per cubic foot.
However, other foam densities can be substituted for
either type of foam, and other materials can be
substituted for the various foam types. Any of the foam
or foam-like materials described may be suitably cut,
20 laser sculpted, molded, injected, stitched, glued, bonded
or other such techniques as are known, in order to achieve
the shapes desired to practice this invention.

If desired, an alternate embodiment of the seat as
shown in FIG. 1 can be constructed for use in, for
25 example, public transportation systems, such as a subway,
bus, or other passenger-carrying vehicle. The seat's foam
30 of FIG. 1 is replaced with a substantially stiff
material, such as fiberglass reinforced ABS. The stiff
"cushion" member preferably has air channels molded or cut
into its structure. At least partially encapsulating the
stiff "cushion" member is a substantially resilient
member, preferably formed of a reticulated foam layer or
the like. If desired, an air-permeable structural wall,
such as a adhesive tape with holes, or a plastic screen
35 with holes, can be placed between the reticulated foam
layer and the stiff cushion or plastic seat. By adding
this structural screen or tape, it is more difficult for

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1 an occupant to feel the channels in the stiff materials
with either their body while they are sitting, or with
their hands. This screen acts in a similar manner as the
adhesive backed material described previously. The seat
5 arrangement is covered so as to substantially encapsulate
the plastic channel cushion, the plastic screen and the
reticulated foam, for example, with seat covering material
similar to that previously described. The seat components
can be assembled via stitching, screwing, bonding, gluing,
10 cutting, and other means of attachment as is known.

The practice of the invention disclosed herein
provides an easy and preferable means with which to
construct a variable temperature seat. This provides for
a convenient manner for environmentally comforting the
15 seat's occupant.

While only preferred embodiments of the invention are
described herein in detail, the invention is not limited
thereby. It is believed that the advantages and improved
results of the invention will be apparent from the
20 foregoing description. It will be apparent that various
changes and modifications may be made without departing
from the spirit and scope of the invention as sought to be
defined in the following claims.

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